

Adjustments to the Global Innovation Index Framework and Year-on-Year Comparability of Results

The Global Innovation Index (GII) is a cross-country performance assessment, compiled on an annual basis, which continuously seeks to update and improve the way innovation is measured. The GII report pays special attention to making accessible the statistics used in the Country/Economy Profiles and Data Tables, providing data sources and definitions, and detailing the computation methodology (Appendices I, II, III, and IV, respectively). This annex summarizes the changes made this year and provides an assessment of the impact of these changes on the comparability of rankings.

Adjustments to the Global Innovation Index framework

The GII model is revised every year in a transparent exercise. This year, no change was made at either the pillar or the sub-pillar level.

Beyond the use of World Intellectual Property Organization (WIPO) data, we collaborate with both public international bodies such as the International Energy Agency; the United Nations Educational, Scientific and Cultural Organization (UNESCO); the United Nations Industrial Development Organization (UNIDO); the International Telecommunication Union (ITU); and the Joint Research Centre of the European Commission (JRC) as well as with private organizations such as

Table 1: Changes to the Global Innovation Index framework

GII 2016		Adjustment	GII 2017	
4.2.3	Total value of stocks traded, % GDP	Removed		
4.2.4	Venture capital deals/bn PPP\$ GDP	Number changed	4.2.3	Venture capital deals/bn PPP\$ GDP
5.3.4	Foreign direct investment net inflows	Name and methodology changed	5.3.4	Foreign direct investment net inflows (3-year avg.)
6.3.4	Foreign direct investment net outflows	Name and methodology changed	6.3.4	Foreign direct investment net outflows (3-year avg.)
7.3.3	Wikipedia monthly edits	Name and methodology changed	7.3.3	Wikipedia yearly edits

Note: Refer to Annex 1 and Appendix III for a detailed explanation of terminologies. Indicators whose name did not change but methodology at the source did are not part of this list. Refer to Appendix III for a detailed explanation of methodological changes at the source.

the International Organization for Standardization (ISO); IHS Global Insight; QS Quacquarelli Symonds Ltd; Bureau van Dijk (BvD); ZookNIC Inc; and Google to obtain the best available data on innovation measurement globally.

Table 1 provides a summary of adjustments to the GII 2017 framework for quick reference. A total of five indicators were modified this year: one indicator was removed, one indicator changed its number as a result, and three indicators underwent methodological and name changes. Indicators that retained the same name as last year but are derived from a source that changed

its methodology are not identified in Table 1.

The statistical audit performed by the JRC (see Annex 3) provides a confidence interval for each ranking following a robustness and uncertainty analysis of the modelling assumptions.

Sources of changes in the rankings

The GII compares the performance of national innovation systems across economies, and it also presents changes in economy rankings over time.

Importantly, scores and rankings from one year to the next are not

directly comparable (see Annex 2 of the GII 2013 for a full explanation). Making inferences about absolute or relative performance on the basis of year-on-year differences in rankings can be misleading. Each ranking reflects the relative positioning of that particular country/economy on the basis of the conceptual framework, the data coverage, and the sample of economies—elements that change from one year to another.

A few particular factors influence the year-on-year ranking of a country/economy:

- the actual performance of the economy in question;
- adjustments made to the GII framework;
- data updates, the treatment of outliers, and missing values; and
- the inclusion or exclusion of countries/economies in the sample.

Additionally, the following characteristics complicate the time-series analysis based on simple GII scores or rankings:

- **Missing values.** The GII produces relative index scores, which means that a missing value for one economy affects the index score of other economies. Because the number of missing values decreases every year, this problem is reduced over time.
- **Reference year.** The data underlying the GII do not refer to a single year but to several years, depending on the latest available year for any given variable. In addition, the reference years for different variables are not the same for each economy. The motivation for this approach

is that it widens the set of data points for cross-economy comparability.

- **Normalization factor.** Most GII variables are normalized using either GDP or population. This approach is also intended to enable cross-economy comparability. Yet, again, year-on-year changes in individual variables may be driven either by the variable's numerator or by its denominator.
- **Consistent data collection.** Finally, measuring year-on-year performance changes relies on the consistent collection of data over time. Changes in the definition of variables or in the data collection process could create movements in the rankings that are unrelated to true performance.

A detailed economy study based on the GII database and the country/economy profile over time, coupled with analytical work on grounds that include innovation actors and decision makers, yields the best results in terms of grasping an economy's innovation performance over time as well as possible avenues for improvement.

Methodology and data

The revision of the computation methodology for certain individual indicators has caused shifts in the results for several countries.

For indicator 3.3.1, which measures energy use, the constant PPP\$ per kg of oil equivalent was updated from 2005 PPP\$ to 2010 PPP\$.

The methodology underpinning indicators 4.2.3 and 5.2.4 expanded to use datasets from previous years to improve data coverage.

For indicators 5.3.4 and 6.3.4, the net inflows and outflows of foreign

direct investment are now being measured as an average of the most recent three years to produce a more stable reflection of these indicators' datasets.

The underlying methodology for indicator 7.3.3 has also changed; it now measures edits within each economy by year rather than by month.

Missing values

Since its inception, the GII has had a positive influence on data availability, increasing awareness of the importance of submitting timely data. The number of data points submitted by economies to international data agencies has substantially increased in recent years. In the GII 2016, 12.8% of data points were missing; this year, in the GII 2017, coverage improved again, with only 10.3% of data points missing.

When it comes to country coverage, the objective is to include as many economies as possible. However, it is also important to maintain a good level of data coverage within each of these economies. Because the GII results are linked to data availability (see the JRC Statistical Audit presented in Annex 3 for more details), which affects the overall GII ranks, this year the minimum data coverage threshold rule was strengthened—on the recommendation of the JRC—to maintain the significance of both the GII results and the country sample. To be included in the GII 2017, an economy must have a minimum symmetric data coverage of 36 indicators in the Innovation Input Sub-Index (66%) and 18 indicators in the Innovation Output Sub-Index (66%), and it must have scores for at least two sub-pillars per pillar. Missing values are indicated with 'n/a' and are not considered in the sub-pillar score.

This adjustment derives from a sensitivity that is the result of the data availability, which is less satisfactory

Table 2: GII economies with the most missing values

Economy	Number of missing values	Economy	Number of missing values
Trinidad and Tobago	25	Brunei Darussalam	21
Togo	23	Burkina Faso	20
Burundi	22	Guinea	20
Niger	22	Nepal	20
Benin	21		

Table 3: GII economies with the fewest missing values

Economy	Number of missing values	Economy	Number of missing values
Colombia	0	Israel	3
Hungary	0	Kazakhstan	3
Mexico	0	Netherlands	3
Romania	0	Serbia	3
Bulgaria	1	Slovenia	3
Chile	1	Spain	3
Czech Republic	1	Sweden	3
Malaysia	1	Argentina	4
Poland	1	Croatia	4
Russian Federation	1	Egypt	4
Turkey	1	Latvia	4
Austria	2	Lithuania	4
Brazil	2	Malta	4
France	2	Morocco	4
Italy	2	New Zealand	4
Japan	2	Norway	4
Korea, Rep.	2	Philippines	4
Portugal	2	Switzerland	4
Slovakia	2	Tunisia	4
South Africa	2	United Kingdom	4
Thailand	2	Cyprus	5
Ukraine	2	Georgia	5
Australia	3	Greece	5
Belgium	3	India	5
Costa Rica	3	Ireland	5
Denmark	3	Luxembourg	5
Estonia	3	Moldova, Rep.	5
Finland	3	Panama	5
Germany	3	Singapore	5
Indonesia	3	United States of America	5

in the case of the Output Sub-Index: four countries that were part of the GII 2016 have data coverage below the 66% threshold in the 27 variables in the Output Sub-Index. In contrast, data coverage is satisfactory in all of these cases in the Input Sub-Index (all of these economies have indicator coverage of more than 66% over the 54 input variables). As a result, the following countries included in the GII 2016 dropped out this year: Bhutan, Ghana, Nicaragua, and the Bolivarian Republic of Venezuela.¹ The rules on missing data and the minimum coverage necessary per sub-pillar will be progressively tightened, leading to the exclusion of countries that fail to meet the desired minimum coverage in any sub-pillar (see Appendix I for more details).

Despite requiring minimum levels of coverage, for several economies the number of missing data points remains very high. Table 2 lists the countries that have the highest number of missing data points (20 or more), ranking them according to how many data points are missing.

Conversely, Table 3 lists those economies with the best data coverage, ranking them according to the least number of missed data points. These economies are missing at most only five data points; some are missing none at all.

Note

Conversely, Brunei Darussalam, Trinidad and Tobago, and Zimbabwe—which were not included in the GII 2016—enter the GII this year with the required coverage in both sub-indices and sufficient data availability per pillar.